Waste Analysis Plan for the Treatment of Chemical Oxygen Generators

This Waste Analysis Plan was prepared in accordance with WAC 173-303-300.

Introduction

Chemical oxygen generators are self-contained devices that produce gaseous oxygen through the thermal decomposition of inorganic chlorates into inorganic chlorides and elemental oxygen. These generators are installed in aircraft Passenger Safety Units (PSUs) which are installed in all Boeing Single Aisle Airplanes. Oxygen generators provide gaseous oxygen to passengers and crew in the event of an airborne emergency.

Undischarged chemical oxygen generators are occasionally removed from PSUs, discharged and disposed of as solid or hazardous waste, depending on the generator. Generators are always discharged prior to disposal to reduce risks associated with transportation and disposal.

There are three manufacturers of chemical oxygen generators used by Boeing:

1. Puritan-Bennett Aero Systems (recently changed to BE Aerospace),
2. Drager Aerospace,
3. Scott Aviation Systems

Waste Description

All oxygen generators are discharged in a controlled manner prior to disposal. This is done as a safety measure to prevent uncontrolled activation and the associated generation of heat during the transportation and handling of discarded oxygen generators. The "treatment" of this waste is to activate the oxygen generators per manufacturers' instructions. The resulting reaction is completely contained (except for the breathing oxygen discharged) within the canister.

Chemical oxygen generators produce gaseous oxygen through the thermal decomposition of inorganic chlorates into inorganic chlorides and elemental oxygen. In the oxygen generator, this reaction is facilitated by the presence of fuels and catalysts, which modify the reaction rate, so that the oxygen flow rate can be predetermined, and the reaction zone remains well organized and mechanically stable during the operation of the device.

The chemical core (referred to as the "oxygen candle"), consisting of the inorganic chlorate with fuels and catalysts, is securely contained inside a stainless steel shell. The decomposition reaction is initiated at one end of the core and travels down the length of the oxygen candle until the reaction is complete

The reaction that takes place inside the generator is exothermic. Temperatures in the generator core may reach 550° to 850° C (1000° F to 1500°F). Analyses of discharged generators by Boeing and manufacturers indicate that all the chlorates, perchlorates and peroxides present in un-discharged generators are converted into inorganic chlorides and oxides by the high temperature of the reaction. Prior to discharge, chemical oxygen

generators typically contain the chemicals found in Table 1. Table 2 lists the compounds that are typically present after the generator has been discharged.

The heat-of-reaction generated by activation of the oxygen generators assures all of the oxygen candle is reacted once activated. This is because the decomposition or melting temperatures of the chlorates, perchlorates and peroxides contained in un-discharged generators (listed in Table 3), are lower then the temperatures reached in the core during the reaction, providing futher evidence that these chemicals are not present in a discharged generator.

Table 1 – Chemicals typically present in an undischarged generator

Chemical	%	Function
sodium chlorate	85-90	primary oxygen source
glass powder	2-3	stabilizes melted core material
iron powder	5-6	catalyst & heat source
inorganic peroxides (Ba, Na or Zn)	4-10	modify catalyst activity & controls chlorine formation
inorganic perchlorates (K or Na)	1-2	modify reaction rate & produces some oxygen
metallic oxides (Co, Fe, Mg, Na or Ti)	1-2	primary catalyst

Table 2 – Chemicals typically present in a discharged generator

Chemical	%	Form of Chemical
inorganic chlorides (K or Na)	75-80	
glass powder	2-3	
iron powder	5-6	metal & oxides
inorganic metals (Ba, Na or Zn)	4-10	chlorides & oxides
metallic oxides (Co, Fe, Mg or Ti)	1-2	metals & oxides

Table 3 – Melting/Decomposition points

Chemical	Melting / Decomposition Point (°C)
Potassium Perchlorate	525° ± 10°
Sodium Chlorate	264°, decomposes on heating with production of O_2
Barium Peroxide	450°, loses O_2 at 800°
Sodium Peroxide	460°, decomposes on heating with production of O_2
Zinc Peroxide	decomposes at 150°

Analytical Results

Puritan-Bennett produces oxygen generators with two types of chemical core formulas. Earlier models contain Barium Peroxide while later models contain Calcium Hydroxide.

Barium containing generators can be distinguished by their part number that begins: 17-003-XXX. . Analytical results indicate discharged Puritan-Bennett Barium containing generators exceed WAC 173-303-090 levels for Barium. It is expected that most Puritan-Bennett generators from Single Aisle Airplane Programs contain Barium. These Barium containing generators are characteristic hazardous waste and carry the D005 waste code.

Scott Aviation chemical oxygen generators have not been tested, but based on the manufactures MSDS that indicates the presence of Barium Peroxide at 4%, these generators would exceed WAC 173-303-090 levels for Barium. Please see Appendix A for copies of the MSDSs.

Analytical results from samples of discharged Drager chemical oxygen generators do not exceed WAC 173-303-090 levels and therefor are not toxicity characteristic wastes. This is consistent with the manufacturer's MSDS, which does not indicate the presence of any toxicity characteristic metals. Please see Appendix B for analytical results. However, Sodium Chloride is expected to account for 75-85 percent of the chemicals in the core of these discharged generators. It is expected that the core is one third of the total weight of the discharged generator, which causes these generators to book designate as a Washington State Dangerous Waste. An acute static fish bioassay was completed in accordance with WAC 173-303-100 (5)(c)(i) and resulted in zero mortalities. Therefore, the generator does not designate as a Washington State Dangerous Waste. Please see Appendix C for a copy of the bioassay results.

Analytical Parameters, Sampling Methods and Frequency

Current manufacturers' information and past analytical results are adequate to characterize this waste stream. In the event of any changes in composition, which could result in a different characterization (e.g. change, in toxicity, different metals, etc.) further analysis, will be performed.

A representative grab sample of discharged chemical oxygen generators will be analyzed whenever information is received from manufacturers or other sources that the chemical composition of the generators has changed. The components of the generator will be mechanically separated and combined in one sample to be representative of the entire generator.

The parameter that will be analyzed for is the concentration of heavy metals using Method 1311, the Toxicity Characteristic Leachate Procedure.

Disposal of Discharged Chemical Oxygen Generators

Past analytical and generator knowledge indicate that discharged Puritan Bennett and Scott Aviation generators will exceed the designation levels in WAC 173-303-090 and they will therefore be disposed of as hazardous waste. Discharged Drager generators are expected to be below the designation levels in WAC 173-303-090 and also do not

designate as Washington State Dangerous Wastes per 173-303-100(5)(c)(i). Discharged Drager generators may therefore be managed as Solid Waste.

Appendix A

B/E Aerospace, Inc.

Puritan-Bennett Aero Systems Co.

MATERIAL SAFETY DATA SHEET

Oxygen Generator - Chemical

SECTION I - IDENTIFICATION

Issue Date:	June, 1998
Manufacturer's Name:	Puritan Bennett Aero Systems Co.
Address:	10800 Pflumm Road, Lenexa, Kansas 66215
Emergency Phone No:	913-338-9800 (During Normal Business Hours) 24 Hour Contact: From within the U.S. - 1-800-424-9300 From outside the U.S. - 1-703-527-3887
Chemical Name and Synonyms:	Sodium Chlorate
Trade Name and Synonyms:	Sodium Chlorate; Candles
Chemical Family:	Oxidizer
Formula:	$NaClO_3$

SECTION II - HAZARDOUS INGREDIENTS

Material	CAS No.	OSHA PEL
Sodium Chlorate	7775-09-9	Not Listed
Barium Peroxide	1304-29-6	Not Listed
Iron Powder	7439-89-6	Not Listed
Glass Powder	Not Listed	Not Listed
Ferric Oxide	1309-37-1	10 mg/m^3
Cobalt Oxide	1307-96-6	Not Listed
Potassium Perchlorate	7778-74-7	Not Listed

SECTION III - PHYSICAL DATA

Boiling Point:	Solid (Decomposes)
Vapor Pressure:	Solid
Vapor Density (Air = 1.0):	Solid
Solubility in Water:	80 at 0° C; 206 at 100° C per 100 parts H_2O
Percent Volatile by Volume:	Solid
Evaporation Rate:	Solid
Appearance and Odor:	Gray or white, solid; very slightly hygroscopic

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point.	Does not burn - strong oxidizer
Flammable Limit:	Does not burn - contact with organics and combustible materials may cause fire.
Extinguishing Media:	Flood with water. Never use blankets or powder or CO_2 type extinguishers
Special Fire Fighting Procedures:	If clothing is ignited, douse with water.

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Unusual Fire and Explosion Hazards:	Do not smoke in area. Liberated oxygen may cause an explosion.

SECTION V - HEALTH HAZARD DATA

ACGIH Time Weighted Average Exposure Limit (TWA):	Not Listed
ACGIH Short Term:	Exposure Limit (STEL): Not Listed
Effects of Overexposure:	Do not take internally
Emergency and First Aid Procedures:	Remove to fresh air. If breathing is difficult, administer oxygen. If breathing has stopped, administer artificial respiration. Obtain prompt medical attention. During use, generator may reach 450-500° F and cause 1st and 2nd degree burns
Carcinogenicity	Not listed in NTP or IARC; not regulated as a carcinogen by OSHA.

SECTION VI - REACTIVITY DATA

Stability:	Stable when stored properly
Conditions to Avoid:	Do not expose to heat or flame. Decomposes above 265° C
Materials to Avoid:	Acids (may cause explosion), wood, combustible materials, heat, flames
Hazardous Decomposition Products:	Oxygen
Hazardous Polymerization:	None

SECTION VII - SPILL OR LEAK PROCEDURE

Steps to be taken in case material is released or spilled:	Remove ignition sources. Avoid handling or transporting chlorates on asphalt or plastic tile or on wood floors. Avoid conditions where wood may become contaminated. Prevent from contacting acids, organic materials, sulfur and sulfides, phosphorus, powdered metals, ammonium compounds and combustible materials. Sweep up dry spillage immediately into metal containers or wash into an industrial sewer.
Waste Disposal Method:	Unused chemical oxygen generators contain oxidizers, and when activated, they produce gaseous oxygen and their surface becomes very hot. This includes chemical oxygen generators which are at the end of their service life. Oxidizers, including gaseous oxygen, can react vigorously with other materials to lower ignition temperature, promote combustion, and accelerate fires. Unused chemical oxygen generators must be packaged, labeled, transported, and disposed in accordance with applicable national, state, and local regulations. PBASCo strongly recommends that operators discharge chemical generators which have reached the end of useful life. To do this, follow these steps: • Remove dust caps from generator tubing connections, if they are present.

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- Place generator on a noncombustible surface, away from oil, grease, paper, or other combustible materials.
- Pull actuation pin to start the flow of oxygen.
- Do not touch the generator with unprotected hands, as it is hot enough to burn the skin. Allow the generator to cool before handling, or use protective gloves.

Used oxygen generators may contain materials which are subject to hazardous waste disposal regulations. Dispose of used chemical oxygen generators in accordance with applicable national, state, and local regulations.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Eye Protection:	Splash-proof safety goggles
Protective Gloves:	Neoprene. Never wear leather
Local Exhaust:	Recommended
Ventilation:	Store & use only in a well-ventilated area.
Respiratory Protection:	See Section VII
Other Protective Equipment:	Rubber shoes or boots. Never wear shoelaces. Wash clothes daily. Use headcovering.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be taken in handling and storage:	Chlorate handling areas must be kept clean.
Other Precautions:	Avoid contact with organic materials, heat sources, acids, oxidizable materials and heat.

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SCOTT AVIATION

MATERIAL SAFETY DATA SHEET

SECTION 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Oxygen Generator (chemical)
PRODUCT P/N: 803338-01, 803000 Series, 801386-11

SCOTT AVIATION
225 ERIE STREET
LANCASTER, NY 14086

EMERGENCY TELEPHONE: 716-683-5100

INFORMATION TELEPHONE:716-686-1725

REVISION DATE: September 27, 1996 - 0496L010.DOC

SECTION 2- COMPOSITION/INFORMATION ON INGREDIENTS

Note: This device is a solid state chemical generator which is classified as an "Article" as defined in 29 CFR 19100.1200(c), and as such does not require an MSDS. However, for Federal procurement, an MSDS is required per Appendix A Federal Standard No. 313, 10.1.3(d) which lists oxidizers as Hazardous by definition in 49 CFR 173.151. The first three components are oxidizers.

CHEMICAL	CAS#	% BY WT.	EXPOSURE LIMITS
Sodium Chlorate	7775-09-9	85.0	
Potassium Perchlorate	7778-74-7	0.5	
Barium Peroxide	1304-29-6	4.0	0.5 mg/m3 - TLV
Iron Oxide	1309-37-1	3.5	10.0 mg/m3 - TLV (fumes)
Magnesium Oxide	1309-48-4	2.0	15.0 mg/m3 - TLV (particulate)
Mica	12001-26-2	2.0	20.0 mppcf
Titanium Dioxide	13463-67-7	2.0	15.0 mg/m3 - TLV (total dust)

SECTION 3 - HAZARDS IDENTIFICATION

POTENTIAL HEALTH EFFECTS:

EYE CONTACT: May cause local irritation.

SKIN CONTACT: Sodium Chlorate is mildly irritating to the skin. May cause rash.

INGESTION: Both Barium and Sodium Chlorate are toxic if ingested. Reported lethal doses of sodium chlorate are 2 grams for children and 15 - 30 grams for adults.

INHALATION: Dust from the chemical core may cause irritation to the mucous membranes, throat and nose.

VENDOR 603279
MSDS# 34258 T-N

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SECTION 4 - FIRST AID MEASURES

EYE CONTACT: Flush eyes with a directed stream of water for at least 15 minutes. Forcibly hold eyelids apart to ensure complete irrigation of all eye and lid tissue. Get immediate Medical attention if irritation occurs.

SKIN CONTACT: Wash affected area with soap and water. Get prompt Medical attention if irritation occurs.

INHALATION: Avoid breathing excessive dust. Remove to fresh air at once.

INGESTION: Contact physician immediately.

SECTION 5 - FIRE FIGHTING MEASURES

FLASH POINT: NA
FLASH POINT METHOD: NA

FLAMMABLE LIMITS: NA

AUTOIGNITION TEMPERATURE: NA

OSHA FLAMMABILITY CLASSIFICATION: NA

EXTINGUISHING MEDIA: Water

UNUSUAL FIRE AND EXPLOSION HAZARDS: Oxidizers generate their own oxygen as they burn and therefore cannot be extinguished by means other than water. Do NOT use CO2 or dry extinguishers as they are ineffective and may create a worse situation.

SPECIAL FIREFIGHTING PROCEDURES: Avoid bodily contact. Wear self contained breathing apparatus and wear appropriate protective equipment. Keep material from exposure to high heat by using water to cool containers and diluting the oxidizing materials.

SECTION 6 - ACCIDENTAL RELEASE MEASURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: It is recommended to vacuum all spillage with a high efficiency type vacuum and then be placed into a closed container. If vacuuming is not possible then spillage should be wet down before sweeping.

SECTION 7 - HANDLING AND STORAGE

STORAGE TEMPERATURE: Room Temperature.

STORAGE PRESSURE: NA

GENERAL: Do not store in wet or moist areas.

SECTION 8 - EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS:

PERSONAL PROTECTION: Impervious gloves should be worn if handling the chemical core or dust from the chemical core.

SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

VAPOR PRESSURE: NA
SPECIFIC GRAVITY: 0.92
SOLUBILITY IN WATER: Appreciable
pH: 11.8
APPEARANCE: Compressed gray granular form
ODOR: None

VAPOR DENSITY: NA
(AIR =1)
EVAPORATION RATE: NA
(n-BUTYL ACETATE =1)
DENSITY, LB/GAL
PHYSICAL STATE: Solid

SECTION 10 - STABILITY AND REACTIVITY

CONDITIONS TO AVOID: Avoid storing, mixing or contaminating with chemicals, mineral acids, and combustible materials.

INCOMPATIBILITY: Oils, organic metals, and acids.

HAZARDOUS DECOMPOSITION PRODUCTS: Can include chlorine and chlorine dioxide.

HAZARDOUS POLYMERIZATION: Will not occur

STABILITY: Stable

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SECTION 11 - TOXICOLOGICAL PROPERTIES

No data available.

SECTION 12 - ECOLOGICAL INFORMATION

No data available.

SECTION 13 - DISPOSAL CONSIDERATIONS

Generators must be spent prior to disposal. Due to the barium within the generator it is considered a hazardous waste even after it is spent. The spent generator must be disposed of in accordance with all Federal and State regulations.

SECTION 14 - TRANSPORTATION INFORMATION

DOT PROPER SHIPPING NAME:	Oxidizing Solid, N.O.S. (contains sodium chlorate and barium peroxide)
DOT HAZARD CLASS:	5.1
DOT UN/NA NUMBER:	UN 1479
PACKING GROUP:	II
ADDITIONAL MARKINGS:	Oxygen Generator (chemical)

SECTION 15 - REGULATORY INFORMATION

U.S. FEDERAL REGULATIONS: AS FOLLOWS -

OSHA: All chemicals listed are considered hazardous or toxic under 29 CFR 1910.1000.

SARA SECTION 313: Barium as an element is reportable under SARA.

TOXIC SUBSTANCES CONTROL ACT: Barium as an element.

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SECTION 16 - OTHER INFORMATION

HMIS RATINGS: For Sodium Chlorate
HEALTH: 2
FLAMMABILITY: 0
REACTIVITY: 2

LEGEND:
NA - NOT APPLICABLE
NE - NOT ESTABLISHED
ND - NOT DETERMINED
mppcf - millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.

The information contained herein is, to the best of our knowledge and belief, accurate. However, Scott Aviation assumes no liability whatsoever for the accuracy or completeness of the information contained herein. Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist. It is the responsibility of the user to comply with all applicable Federal, State, and Local laws and regulations.

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Aerospace GmbH

Dräger

MATERIAL SAFETY DATA SHEET

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name :	DRÄGER Generator-Emer-Oxy
Product Code :	E 7 xyz 0 (x = 1, 2, 4; y = 0, 2, 7; z = 2, 3, 4)
Chemical Family :	Oxidizer, Oxygen generator, Sodium Chlorate
Revision :	March 25, 1998, Document No. : 9030067 generate.doc
Manufacturer :	DrägerAerospace GmbH Moislinger Allee 53 - 55 FRG 23558 Lübeck
	Telephone +49 451 882-0 Fax +49 451 882-2080
US Emergency Telephone Number :	Infotrac: 1-800-535-5053
International Telephone Number :	+49 451 882-2395

2. COMPOSITION / INFORMATION OF INGREDIENTS

The DRÄGER Generator-Emer-Oxy is a emergency oxygen system on the basis of sodium chlorate. The chemical system in the oxygen generator consist mainly of sodium chlorate and alkalihydroxides and peroxides. The oxygen generator is hermetically sealed.

Component	CAS#	%	Exposure Limits
Sodium chlorate	7775-09-9	less than 95	none (oxidizer)
Sodium peroxide	1313-60-6	less than 10	none (oxidizer)
Sodium monoxide	1313-59-3	less than 5	none (see Sodium hydroxide)
Mica	12001-26-2	less than 3	NIOSH, 3 mg/m³
Magnesium	7439-95-4	less than 1	none
Sodium perchlorate	7791-07-3	less than 2	none (oxidizer)
Glaspowder	-	less than 2	none
Zinc peroxide	1314-22-3	less than 2	none

3. HAZARD IDENFICATION

POTENTIAL HEALTH EFFECTS (Only applicable in case of direct contact with the chemicals of the oxygen generator) :

ROUTE(S) OF ENTRY :
Skin and eyes contact with dusts and inhalation of dusts.

HUMAN EFFECTS AND SYMPTOMS OF OVEREXPOSURE :

EYES :
Causes burns.

SKIN :
Causes burns. Irritation to skin. May cause rash.

VENDOR 004345
MSDS# 91976 Trv

INHALATION :
Causes burns, and may cause irritation to the mucous membranes, throat and nose.

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Material Safety Data Sheet
Product: **Dräger Generator-Emer-Oxy** revised on : 03/98
Date of issue : March 25, 1998
Version : 03/98

INGESTION :
After ingestion irritations of mucous membranes in the mouth, pharynx, oesophagus, and gastrointestinal tract. Risk of perforation in the oesophagus and stomach. Sodium chlorate is toxic if ingested.

CARCINOGENICITY :
Not listed in NTP or IARC; not regulated as a carcinogen by OSHA.
OSHA : Not listed.

4. FIRST AID MEASURES

(applicable in case of direct contact with the chemicals of the oxygen generator.)

SKIN :
Wash off with plenty of water. Dab with polyethylene glycol 400. Immediately remove contaminated clothing. Get medical attention if irritation occurs.

EYES :
Wash eyes immediately with large amounts of water for about 15 minutes with the eyelid hold wide open. Get immediately medical attention.

INGESTION :
If swallowed: give plenty of water to drink, induce vomiting. Immediately summon doctor. Keep airways free.

INHALATION :
Remove to fresh air immediately. If breathing has stopped give artificial respiration. If breathing is difficult administer oxygen. Get medical attention immediately.

5. FIRE, FIGHTING MEASURES (EXPLOSION DATA)

Flash Point	n. a.
Flash Point Method	n. a.
Flammable Limits	n. a.
Autoignition Temperatures	n. a.

EXTINGUISHING MEDIA :
Cover with dry sand or cement.

EXTINGUISHING MEDIA NOT TO BE USED :
Do not use CO_2 or dry extinguishers as they are ineffective and may create worse situation.

SPECIAL FIRE FIGHTING PROCEDURES :
Wear personal protective equipment, and self-contained breathing apparatus. Keep oxygen generators from exposure to high heat. Use protective water spray to keep fire-exposed containers cool.

SPECIAL RISKS
Fire-promoting. Oxidizers generate their own oxygen as they burn. Keep away from combustible materials. Danger of explosion!

6. ACCIDENTAL RELEASE MEASURES

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Material Safety Data Sheet — Date of issue : March 25, 1998
Product: **Dräger Generator-Emer-Oxy** revised on : 03/98 Version : 03/98

SPILL AND LEAK PROCEDURES:
Careful take up dry. Clean up affected area. Avoid generation of dusts. Do not inhale dusts. Loose chemicals and components should be carefully placed into a metal container.

7. HANDLING AND STORAGE

HANDLING :
Carefully handling, no shocks and stress. After activation the generator may produce oxygen up to 30 min.
Warning: High temperature device! During use, generator may reach 500 - 600 °F and cause 1st and 2nd degree burns. The discharge of oxygen may support the fire. In case of contact to organic, substances, oil and graese the oxygen may cause explosions.

STORAGE :
Store in tight containers, away from heat, and humidity. Keep away from water. Store tightly closed, dry, away from combustible substances. Do not store at temperatures above 210 °F.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

(applicable in case of direct contact with the chemicals of the oxygen generator)

SKIN PROTECTION :
Wear protective clothing and impervious rubber gloves.

EYES PROTECTION
Wear protective goggles or full-face shield. Contact lenses should not be worn.

RESPIRATORY PROTECTION:
An approved positive pressure air-supplied respirator is required whenever dusts are generated.

9. PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE :
A compressed, white, chemical core enclosed within a metal canister.

PHYSICAL FORM :
n. a.
COLOR :
n. a.

ODOR :
none

SOLUBILITY IN WATER :
n. a.

BOILING POINT :
n. a.

SPECIFIC GRAVITY :
varies

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Aerospace GmbH

Dräger

Material Safety Data Sheet
Product: Dräger Generator-Emer-Oxy revised on : 03/98
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VAPOR PRESSURE :
n. a.

10. STABILITY AND REACTIVITY

CONDITIONS TO AVOID :
Avoid storing, mixing or contaminating with chemicals, mineral acids, and combustible materials.

CHEMICAL STABILITY :
Stable

HAZARDOUS DECOMPOSITION PRODUCTS :
Discharge of oxygen which may support the fire (can include chlorine and chlorine dioxide).

POLYMERIZATION :
N. a.

INCOMPATIBILITIES :
Avoid acids, water, organic combustible substances, oil, grease.

11. TOXICOLOGICAL INFORMATION

(applicable to the chemicals of the oxygen generator)

LD 50 (oral rat) : 1200 mg/kg
LC 50 (inhal. rat) : n. a.
LD 50 (oral rat) : n. a.

ACUTE TOXICITY :
Reported lethal doses of sodium chlorate are 2 grams for children and 5 - 10 grams for adults.

FURTHER TOXICOLOGICAL INFORMATION :
none

12. ECOLOGICAL INFORMATION

No data available.

Avoid contamination of ground water and waterways.
Adverse ecological effects cannnot be excluded in the event of improper handling or disposal.

13. DISPOSAL CONSIDERATIONS

Generatory must be spent prior to disposal. The spent oxygen generators must be disposed of or incinerate in accordance with Local, State and Federal regulations.

14. TRANSPORT INFORMATION

(Not meant to be all inclusive)

DOT SHIPPING NAME : Oxygen generator, chemical

REA 84000882
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Aerospace GmbH

Dräger

Material Safety Data Sheet
Product: **Dräger Generator-Emer-Oxy** revised on : 03/98
Date of issue : March 25, 1998
Version : 03/98

ADDITIONAL INFORMATION : Special Shipping restrictions apply. Refer to United States Code of Federal Regulations (CFR 49) or other applicable governmental regulations. Government approval, exemptions or permits may be required.

HAZARD CLASS : 5.1; PG II, CAO

UN# 3356

LABEL : Oxidizer

15. REGULATORY INFORMATION (Not meant to be all inclusive)

This device is a chemical oxygen generator and is classified as an „Article" as defined in 29 CFR 19100.1200 (b)(6)(v) - July 1, 1995. Therefore, this device does not require a Material Safety Data Sheet. However, for Federal procurement, a MSDS is required per Federal Standard No. 313 C (GSA Federal Supply Service).

16. OTHER INFORMATION

This product contains the toxic chemical listed below.
Sodium chlorate ($NaClO_3$) CAS 7775-09-9

The above information represents our current state of experience and describes the product only with respect to safety requirements. However, Dräger Aviation assumes no liability whatsoever for the accuracy or completeness of the information contained herein. It is the responsibility of the customer to test whether the product is suitable for the purpose intended by the customer.

All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards which exist. It is the responsibility of the user to comply with all applicable Federal, State, and Local laws and regulations. Any questions of warranty and liability for this product are subject to our General Terms and Conditions unless legislation provides otherwise.

Material Safety Data Sheet issued by : Quality and Environment Contact : Dr. H.-Chr. Bechthold

This MSDS supersedes edition of February 16, 1998. The data in the section 2 have been changed.

REA 84000883
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Appendix B

RENTON ENVIRONMENTAL LABORATORY REPORT

HAZARDOUS WASTE REPORT

Lab Id: 98-B844
Field Id No.: Oxygen Generator "Drager"

Field Notes: Interior powder only

Analyte	Result	Units	Method #	Analyst	Date	Status
TCLP Extraction						
Arsenic:	< 0.05	ppm	200.7	Paula	11/23/98	
Barium:	0.10	ppm	200.7	Paula	11/23/98	
Cadmium:	< 0.01	ppm	200.7	Paula	11/23/98	
Chromium:	0.36	ppm	200.7	Paula	11/23/98	
Lead:	0.10	ppm	200.7	Paula	11/23/98	
Mercury:	< 0.1	ppm	200.7	Paula	11/23/98	
Selenium:	< 0.05	ppm	200.7	Paula	11/23/98	
Silver:	< 0.01	ppm	200.7	Paula	11/23/98	

Report prepared by: Paula Cockerham Date: 11/23/98

Report approved by: Linda C Riquette Date: 11/23/98

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RENTON ENVIRONMENTAL LABORATORY REPORT

HAZARDOUS WASTE REPORT

Lab Id: 98-B845
Field Id No.: Oxygen Generator "Dräger"

Field Notes: Whole canister'

Analyte	Result	Units	Method #	Analyst	Date	Status
TCLP Extraction						
Arsenic:	< 0.05	ppm	200.7	Paula	11/23/98	
Barium:	0.29	ppm	200.7	Paula	11/23/98	
Cadmium:	< 0.01	ppm	200.7	Paula	11/23/98	
Chromium:	0.42	ppm	200.7	Paula	11/23/98	
Lead:	0.46	ppm	200.7	Paula	11/23/98	
Mercury:	< 0.1	ppm	200.7	Paula	11/23/98	
Selenium:	< 0.05	ppm	200.7	Paula	11/23/98	
Silver:	< 0.01	ppm	200.7	Paula	11/23/98	

Report prepared by: Paula Cockerham Date: 11/23/98

Report approved by: Linda Chriquette Date: 11/23/98

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Appendix C

OGDEN ENVIRONMENTAL AND ENERGY SERVICES

Ogden Bioassay Northwest Laboratory
5009 Pacific Hwy. East, Suite 2-0
Fife, WA 98424
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BIOASSAY REPORT

to

Boeing
Environmental Analysis Laboratory
PO Box 3707 MC 72-04
Seattle, WA 98124-2207

December 1999

Submitted: December 21, 1999

Bioassay Report

INTRODUCTION

A dangerous waste characterization using the test organism *Oncorhynchus mykiss* was performed on a Drager oxygen generator submitted by Boeing to Ogden Environmental. The project manager was Michelle Earl of Boeing. Extraction of the sample was started December 11, 1999 and the test was conducted between December 15 and December 19, 1999 at the Ogden Bioassay Laboratory located in Fife, Washington.

MATERIALS AND METHODS

The material tested was a Drager oxygen generator, #S417T401-42, sampled December 8, 1999. Detailed sample information is shown in Table 1.

Table 1. Sample Information

	Sample ID Drager oxygen generator # S417T401-42
Sample Date	12/8/99
Sample Time	1000
Receipt Date	12/10/99
Receipt Time	1125
Sample Condition	Sample received in good condition
Sample Description	One metal canister

The oxygen generator was comprised of a metal canister containing reactive material surrounded by metal mesh and insulation. The canister was cut open and each component weighed to determine the proportion of each material. The amount of each component required for the final test concentrations of 100-ppm and 10-ppm to contain the same proportions as the original sample was determined. The materials were then weighed into glass jars and filled with 200 milliliters of dechlorinated water. Extraction was initiated on December 12, 1999.

Test conditions are summarized on page 3.

SUMMARY OF TEST CONDITIONS

Dangerous Waste Characterization	**Ogden Test No: 99W12-11**
Test initiation	
Date	12/15/99
Time	1200
Test termination	
Date	12/19/99
Time	1200
Endpoint:	Mortality or 96-hours
Test chamber:	Glass chamber, 20" x 10" x 15"
Test temperature:	12°C (temp. range in test chambers: 12.5-12.8)
Dilution water:	Carbon filtered tap water
Test concentrations:	100 ppm, 10 ppm, 0
Test solution volume:	10 liters
Number of organisms/ chamber:	10
Number of replicates/concentration:	3
Test organism:	*Oncorhynchus mykiss* (rainbow trout)
Animal Source:	Thomas Fish Company, Anderson CA
Animal Age:	65 days from swim up
Food:	Trout chow, no feeding during test
Mean weight:	0.31 g
Mean length:	29 mm
Ratio of longest to shortest:	1.19
Loading:	0.31 g/liter
Photoperiod:	16 hours light/ 8 hours dark
Extraction:	Rotary agitation (30 +/- 2 rpm) for 18 hours
Deviations:	None

RESULTS

A summary of results for the dangerous waste characterization conducted on the Drager oxygen generator submitted by Boeing is contained in Table 2. There was 100 percent survival in both the 100-ppm and 10-ppm concentrations.

Table 2: Summary of Results

Sample ID	Concentration	Mortality*	% Mortality
Drager O_2 generator	100 ppm	0/30	0
	10 ppm	0/30	0
Control	0	1/30	3.3

* # dead fish/ total # fish

QUALITY ASSURANCE

A reference test to monitor laboratory performance using the test species *Oncorhynchus mykiss* was run concurrently with the Boeing sample. The LC50 of 72.46 ppb $CuSO_4$ as Copper fell within laboratory control chart limits. The coefficient of variation (CV) for the last 18 tests is 41.9%, which is considered good by the Biomonitoring Science Advisory Board.

REFERENCES

"Laboratory Guidance and Whole Effluent Toxicity Test Review Criteria." Washington State Department of Ecology Publication # WQ-R-95-80. December 1998.

"Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms." Fourth Edition. EPA/600/4-90/027F. August 1993.

Appendix A

Test Data

Dangerous Waste Toxicity Test
Toxicity Test Data Sheet - Ogden Bioassay Laboratory

Client: Boeing
Sample ID: Drager O2 generator
Contact: Michelle Earl
Test #: 99W12-11

Start Date & Time: 12/13/99 1200
End Date & Time: 12/17/99 1200
Test Organism: O. mykiss
Test Protocol: Washington State Department of Ecology Publ. 80-12

Conc.	Rep	Cont #	Number of Live Organisms 0	24	48	72	96	Dissolved Oxygen (mg/L) 0	24	48	72	96	pH (units) 0	24	48	72	96	Conductivity (umhos/cm) 0	24	48	72	96	Temperature (°C) 0	24	48	72	96	Percent Survival
0	1	24	10	10	10	10	10	8.9	10.2	9.9	9.7	8.9	7.76	7.67	7.67	7.68	7.73	97.1				113						96.7%
	2	10	10	10	10	10	10	9.0	10.3	10.0	9.7	9.0	7.73	7.65	7.66	7.60	7.70	92.9				118						
	3	20	10	10	10	10	9	8.7	10.2	9.7	9.5	9.2	7.48	7.70	7.65	7.65	7.72	105.5				104	12.5	12.5	12.5	12.5	12.5	
2 ppm	1	17	10	10	10	10	10	9.0	10.3	10.0	9.8	9.2	7.70	7.70	7.67	7.72	7.76	111.1				116						100%
	2	19	10	10	10	10	10	8.7	10.2	10.0	9.8	9.2	7.73	7.69	7.67	7.73	7.77	113.1				117	12.5	12.6	12.5	12.5	12.5	
	3	14	10	10	10	10	10	9.1	10.3	10.0	9.8	9.1	7.77	7.70	7.66	7.70	7.77	102.8				115						
20 ppm	1	1	10	10	10	10	10	9.0	10.2	10.0	9.7	9.2	8.43	7.84	7.69	7.79	7.72	173.2				189						100%
	2	22	10	10	10	10	10	9.1	10.3	10.2	9.9	9.3	8.48	7.91	7.75	7.75	7.77	193.5				204						
	3	12	10	10	10	10	10	9.0	10.3	10.0	9.8	9.4	8.59	7.87	7.71	7.71	7.76	188.8				192	12.6	12.6	12.8	12.5	12.5	
	1																											
	2																											
	3																											
	1																											
	2																											
	3																											
	1																											
	2																											
	3																											
Technician Initials			BS	BS	BS	BS	BS																					

Conc.	Alkalinity* Initial		Alkalinity* Final		Hardness* Initial	Hardness* Final
Control	52	BS	48		40	52
Test conc.	44		44		40	44

*(mg/L as CaCO3)

Weights (g): .385 .373 .280 .212 .256 .372 .305 .282 .280 .330 μ = .308

Lengths (mm): 32 31 29 27 28 30 29 28 28 30 μ = 29.2

length max/min = 1.2 = 32/27

Sample Description: Extraction started 12/14/99 1300

Comments: 0 hrs: Sludge 10/11/99 DCH 3/27/99

24 hrs.

48 hrs.

72 hrs.

96 hrs.

Analysts: RD BS

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REA 84000893
BVL

B-DUW2-2423613

Appendix B

Reference Toxicant Test Data

Dangerous Waste Toxicity Test

Toxicity Test Data Sheet - Ogden Bioassay Laboratory

Client: Ref tox 500 ug/l Cu as $CuSO_4$

Sample ID:

Contact:

Test #: RT 121590m

Start Date & Time: 12/15/94 1200

End Date & Time: 12/19/94 1200

Test Organism: O. mykiss

Test Protocol: Washington State Department of Ecology Publ. 80-12

Conc. Cu ug/l	Rep	Cont #	Number of Live Organisms 0	24	48	72	96	Dissolved Oxygen (mg/L) 0	24	48	72	96	pH (units) 0	24	48	72	96	Conductivity (umhos/cm) 0	24	48	72	96	Temperature (°C) 0	24	48	72	96	Percent Survival
0	1	24	10	10	10	10	10	8.9	10.2	9.9	9.7	8.9	7.76	7.67	7.67	7.69	7.73	97.1				110						96.7%
	2	10	10	10	10	10	10	9.0	10.3	10.0	9.7	9.0	7.73	7.69	7.66	7.60	7.70	92.9				118						
	3	20	10	10	10	10	9	8.7	10.2	9.7	9.5	9.2	7.78	7.70	7.65	7.65	7.74	105.9				109	12.5	12.5	12.5	12.5	12.5	
31.25	1	6	10	10	10	8	8	8.4	10.4	9.8	9.8	9.5	7.67	7.69	7.61	7.63	7.69	85.2				93						76.7
	2	3	10	10	10	9	7	9.1	10.2	10.1	9.8	9.2	7.68	7.60	7.60	7.67	7.68	82.9				93						
	3	4	10	10	10	9	8	8.9	10.4	10.1	9.8	9.2	7.68	7.74	7.57	7.66	7.66	90.2				94	12.9	12.0	11.9	11.9	11.9	
62.5	1	7	10	10	10	9	9	8.7	9.9	10.1	9.8	9.4	7.68	7.66	7.64	7.65	7.72	83.7				94						66.7
	2	21	10	10	10	6	4	9.1	10.1	9.9	9.8	9.2	7.73	7.67	7.64	7.69	7.76	101.6				113						
	3	8	10	10	9	8	7	8.7	10.1	10.0	9.8	9.3	7.71	7.65	7.61	7.66	7.74	88.1				95	12.5	12.6	12.7	12.8	12.6	
25	1	23	10	9	5	4	3	8.8	10.0	9.9	9.7	9.2	7.71	7.66	7.63	7.70	7.73	101.1				114	12.5	12.5	12.4	12.4		20%
	2	16	10	10	6	3	2	8.4	9.8	9.5	9.8	9.4	7.73	7.69	7.67	7.70	7.78	100.9				113						
	3	9	10	9	1	1	1	9.1	9.9	10.0	10.0	9.8	7.72	7.65	7.62	7.73	7.73	89.1				101						
250	1	18	10	4	0			8.7	9.8	10.0			7.71	7.65	7.67			102.6		114								0
	2	15	10	6	0			8.7	9.6	9.9			7.70	7.64	7.68			98.7		110								
	3	5	10	3	0			8.6	9.8	10.0			7.69	7.62	7.68			86.9		95			12.6	12.5	12.5			
500	1	2	10	0				8.8	9.9				7.64	7.61				85.0	94				12.5	12.5				0
	2	11	10	0				8.9	9.9				7.59	7.60				96.0	107									
	3	13	10	0				9.0	10.0				7.61	7.63				102.2	114									
Technician Initials			BS	BS	BS	BS	BS																					

Conc.	Alkalinity* (mg/L as CaCO3) Initial		Final		Hardness* (mg/L as CaCO3) Initial	Final
control	~~50~~ 48 BS		48		~~60~~ 56	52
best conc.	40		40		48	48

Weights (g): .385 .373 ~~.280~~ .280 .252 .272 .305 .266 .286 .330 μ = .308

Lengths (mm): 32 31 29 27 28 30 24 28 28 30 μ = 29.2

length ~~min/max~~ MIN/MAX = 1.2

Sample Description: ~~Extraction sta~~ BS

Comments: 0 hrs: S/O data 10/11/94 DOH: 9/27/94

24 hrs.

48 hrs.

72 hrs.

96 hrs.

Analysts: RD BS

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Appendix C

Chain of Custody Form